Operating Information

Brush Oscillograph Equipment

BL-902 / BL-902A / BL-943 / BL-943A

MP MASTER
MA34650

BRUSH ELECTRONICS COMPANY
3405 Perkins Avenue Cleveland 14, Ohio. U. S. A.

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SECTION I

For BL-902, BL-902A, BL-943 and BL-943A Magnetic Pen Motors*

GENERAL DESCRIPTION

The magnetic pen motor is an instrument designed to make direct inked records of electrical potentials from DC to 120 cps. It consists of a D'Arsonval moving coil galvanometer element suspended in the field of a powerful Alnico magnet. The inking pen is attached to the upper end of the moving coil system (a-Fig. 1).

Ink is supplied to the pen from an inkwell located behind the pen (c) and is fed to the pen through a length of flexible plastic tubing. Several types of charts may be used with the pen motor, such as the strip chart similar to that used on the complete Brush Oscillographs, or a rotating drum chart. Lateral adjustment of the pen for centering purposes is provided by means of a lever (b-Fig. 1).

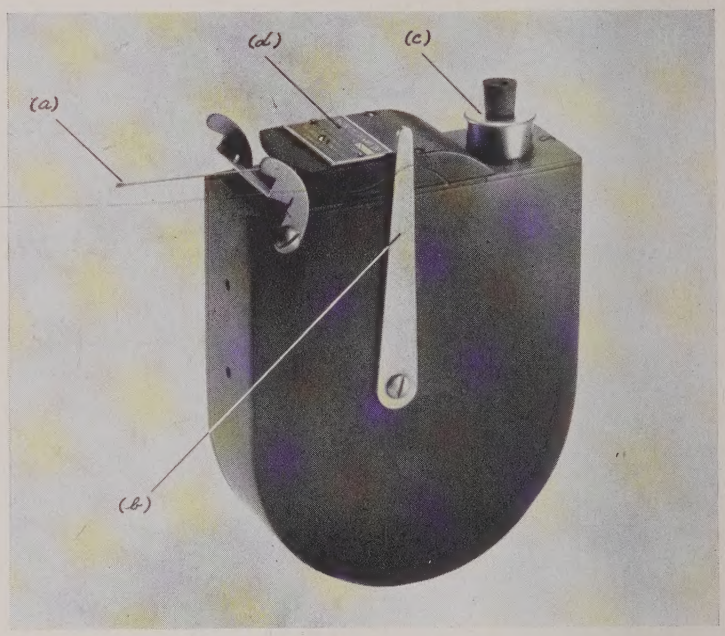

Figure 1

Four types of pen motors are available. The Model BL-902 is designed for use in single-channel Oscillographs where it is remote from other pen motors. The BL-902A is to be used in multi-channel applications where two or more pen motors are operating in close proximity, the magnetism of the magnet of the latter unit being adjusted to take into account the reinforcing action of other nearby magnets.

The Models BL-943 and BL-943A Penmotors are operationally the same as Models BL-902 and BL-902A but are supplied with an electric-stylus as well as with the inking pen. Model BL-902 Penmotors manufactured prior to No. 1465 and Model BL-902A Penmotors prior to No. 5596 cannot be used with an electric stylus (due to the fact that one side of the coil is grounded to the pen mounting yoke).

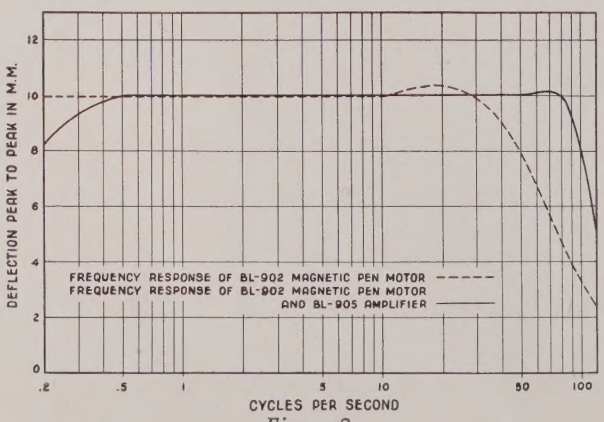

Figure 2

SPECIFICATIONS

(A) ELECTRICAL

1. Frequency Response — essentially uniform from DC to 30 cps, falling to 120 cps (see curve, Figure 2).
2. Minimum Sensitivity: — 1.1 mm per volt, 1.6 mm per milliampere (distances refer to deflections at pen point).
3. Impedance of Driving Coil: — 1500 ohms, resistive.
4. Driver Impedance: — 250 ohms for optimum damping, 500 ohms satisfactory.

*Patent 2478329

5. Recommended Amplitude of Pen Swing:—40 mm (max.) peak to peak up to 70 cps.; 20 mm (max.) at 120 cps.

(B) MECHANICAL

1. Net weight—4 pounds.
2. Dimensions—Height 5″; Width—4″ (not including pen); Thickness—1⅝″; Pen Overhang—1⅜″.
3. Minimum Spacing—1¾″ for mounting pen motors.
4. Mounting Holes—4 holes tapped 8-32; 2″ vertical spacing; ¾″ horizontal spacing.
6. Pen Length—3″.

OPERATION

The pen motor may be driven by a suitable amplifier, or, where sufficient voltage is available, directly from the source. When used without an amplifier, it should be kept in mind that the proper impedance (250 ohms) must be connected across the pen motor at all times. This is important in D. C. applications involving the opening and closing of switches, etc. A pen deflection of 1.1 mm per volt is obtained on direct operation, with a maximum input of 16 volts RMS for full deflection. In the usual type of operation, a circuit that removes the operating voltage and applies it across a 1500 ohm load resistor when the pen is not recording is advantageous both from the standpoint of convenience and pen protection.

The pen motor may be driven by many types of standard amplifiers. However, for optimum performance, the following factors should be taken into consideration. It is generally preferable to connect the pen motor in a cathode follower circuit similar to that shown in Figure 3 as this gives better impedance matching. The amplifier should also provide for some form of overload protection to assure that no signals greater than approximately 20 volts reach the pen motor. Failure to do this may result in pen breakage. Likewise if a uniform response at higher frequencies is desired, the amplifier must provide high frequency compensation. All of the above features are provided in the Brush Amplifiers.

For occasional applications, it is desirable to operate the pen at one edge of the chart as the zero position to allow for greater unilateral deflections. Although the pen may be mechanically offset a considerable distance by means of the pen centering lever, (b) Figure 1, it is well to use this lever to bias the pen only within a few millimeters of the center position because of the stresses set up in the suspension system. However, the pen may be electrically biased to an extreme position without difficulty.

Four types of pens are manufactured for use with the BL-902 and BL-902A pen motors. The pen furnished as standard equipment is model BL-915. This pen gives a medium line .010″ to .018″ in width. For precision work, a fine line pen, model BL-917, giving a trace of .005″ to .009″ wide, is available. For greater legibility at lower frequencies, the model BL-918 pen should be used. This pen has a metal tip and gives a line .024″ wide. The above types are all

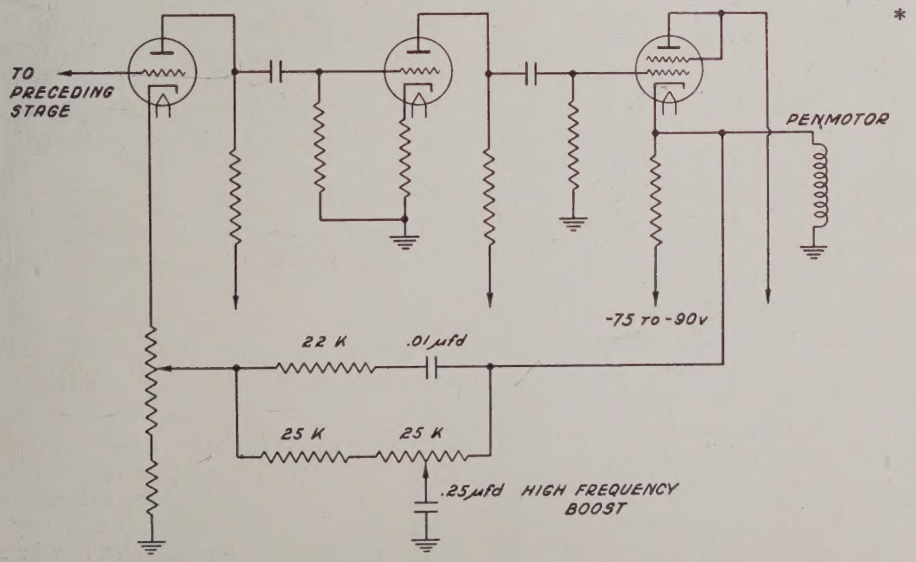

Figure 3

*Note: Proper bias must be supplied to the final stage.

3 inches long. Where greater amplitude is required, a special pen BL-921 having a length of 4¾" is available on special order. The use of this latter pen is not generally recommended, however, since the frequency response of the pen motors is drastically altered.

The Model BL-943 and BL-943A Penmotors are equipped with Model BL-942 three inch long electric stylus as well as with an inking pen.

Four colors of ink are manufactured for use with the pen motor, red, green, purple and black. These inks are specially made for the Brush pens and substitutes should not be used. Ink is available in 2 ounces, pint and quart bottles.

The use of black ink is recommended only when ozalid reproductions are necessary from the chart. A tendency for the black ink to clog makes it advisable to clean the pen at least once a day.

A special anti-freeze purple ink is available to use at low temperatures down to —20°F. Models BL-935 and BL-936 low temperature pens are recommended for use with low temperature ink. They are identical with Model BL-915 and BL-917 pens except the point is cemented with special thermosetting cement to resist solvent action of low temperature ink.

Signals giving less than 2 mm pen deflection may be affected by pen friction. This effect is reduced by operating at higher paper speed. If the signal is small, it is advisable to increase gain if possible.

MAINTENANCE

The magnetic pen motor should require no attention under normal use other than filling the inkwell and keeping the pen inking properly. Suggestions are given below for the care of the inking system.

The pen should never be left off of the paper for any length of time since the ink will dry and clog the pen. When the tip is in contact with the paper, capillary flow will prevent drying and clogging for considerable periods. If the instrument is not to be used for an extended period, however, it is well to wash out the inkwell and pen thoroughly and dry before storing. The inkwell should never be allowed to get very low since any sediment collected in the inkwell will then run into and clog the pens.

If the pens do become clogged, they usually may be cleared by *carefully* holding the point of the pen into the tip of a running water faucet and pressing a finger over the end of the faucet to build up a back pressure through the pen. Considerable finger pressure can be used without damaging the pen. In stubborn cases, the pens may be soaked in warm water prior to using pressure. Use of solvents is not recommended as they may dissolve the cement used to hold the glass points in place.

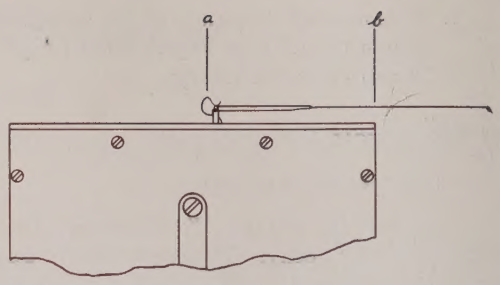

Figure 4

If the ink is subjected to freezing temperatures, a sediment may be precipitated which causes pen blocking. Users should take note of this fact when it is anticipated that the instruments will be subjected to extreme cold.

The tension of the pen point on the paper is controlled by the spring clip (a, Figure 4) which normally rests about 1/32" ahead of the pivot. If this spring is bent or otherwise gets out of adjustment, it should be adjusted so that the tension at point (b, Figure 4) is about 1 gram. Fine nose pliers may be used to bend the spring.

If the pen motor is not operating properly, the trouble may be localized by testing the resistance of the coil at the pen motor terminals. This should be approximately 1500 ohms. Very high or very low readings would indicate an open coil or short circuit. Nonlinear response or poor wave form reproduction might indicate that the coil is rubbing against a pole piece. In any of the above cases, the unit should be returned to the factory as such repairs are difficult in the field.

Occasionally, an unavoidable overload may cause the pen to jump out of its support. It may be easily replaced by removing the metal cover over the base of the pen, (d, Figure 1). Care should be taken not to bend the tension spring (a, Figure 4) any more than is necessary to replace the pen. The plastic ink tubing may be led in from either side of the spring.

Precautions

The intense magnetic field of the pen motors may have an adverse effect on watches worn in the vicinity.

High potential differences between the terminals and pen motor housing or chassis should be avoided.

Mounting screws should not be driven more than 3/16" into the motor case.

Felt pads are provided on the inside of the pen lifter handles to minimize the danger of damage to the inking pen which might result on sudden overloads to the pen motor. Nevertheless surges may bend or break the pen, and in some cases, may burn out the coil.

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CASE

MP MASTER
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